## EXECUTIVE SUMMARY

This Phase III Accreditation Support Package (ASP-III) provides the model user with information about the credibility of *RADGUNS* as well as deficiencies, backed by detailed verification and validation results. The format of information in this package is tailored to identify clearly those areas where the model can be used to support analysis and acquisition decisions; it also succinctly addresses shortcomings which may restrict or otherwise limit application of the simulation to a particular endeavor.

ASP-III presents data that support the degree to which functions simulated reflect reality, as well as an assessment of the accuracy of the code implementation. This information is presented in three main components: a verification report, a functional-level validation report, and a model-level validation report.

*RADGUNS* models simulate performance in three areas common to most threat AAA weapon systems: 1) the RF sensor (radar), 2) the AAA guns, and 3) system operator(s). Functional elements (FEs) within these areas were derived from decomposition of the model via correlation with a hierarchical Functional Area Template (FAT) that is provided in Section 1.0. The FAT is used to both guide and report results of V&V efforts and the RF sensor portion is common among other radar system models. Some FEs, such as Receiver Blanking, Pulse Compression, Doppler Filters, and Doppler Tracking are not modeled in *RADGUNS*.

Table i-1 lists the verification and validation efforts included in ASP-III for *RADGUNS*. Each effort is ranked by the type of verification/validation discrepancies found. FE-level validation efforts are subdivided into face validation efforts, comparisons with S&TI data, and comparisons with T&E data.

TABLE i-1. Summary of ASP-III Verification and Validation Findings.

| Functional Element | No. | Version | 2.0 VER | 3.0 VAL | | | 4.0 VAL |
|---|---|---|---|---|---|---|---|
| | | | | FACE | S&TI | T&E | T&E |
| Flight Path | 1 | 1.8 | | 1 | | | |
| Signature RCS Static | 2 | 1.8 | | 1 | | | |
| Signature Fluctuations | 4 | 1.8 | 2 | | | | |
| On-board Noise ECM | 5 | 2.0 | 2 | | | | |
| On-board Deceptive ECM | 8 | 2.0 | 2 | | | | |
| Clutter | 12 | 1.8 | 2 | | | | |
| Multipath/Diffraction | 13 | 1.8 | 2 | | | | |
| Waveform Generator | 15 | 1.8 | | | 1 | 2 | |
| Thermal Noise | 16 | 1.9 | | | 1 | 2 | |
| AGC | 17 | 1.9 | | | | | 2 |
| Antenna Gain | 20 | 1.9 | 2 | | 1 | | |
| | | 2.0 | | | 1 | | |
| Threshold | 22 | 1.8 | 1 | | | | |
| Clutter Rejection MTI | 23 | 1.8 | 3 | | | | |
| Integration | 25 | 1.8 | 2 | | | | |

TABLE i-1. Summary of ASP-III Verification and Validation Findings. (Contd.)

| Functional Element | No. | Version | 2.0 VER | 3.0 VAL | | | 4.0 VAL |
|---|---|---|---|---|---|---|---|
| | | | | FACE | S&TI | T&E | T&E |
| Angle Track | 27 | 1.8 | 2 | | 2 | | |
| | | 1.9 | | | | | 2 |
| Range Track | 28 | 1.8 | 2 | | 2 | | |
| | | 1.9 | | | | | 2 |
| Aiming Solution | 30 | 1.9 | | | | | 2 |
| Gun Movement | 31 | 1.8 | 2 | | | | |
| | | 1.9 | | | | | 2 |
| Fire Enable/Disable | 32 | 1.8 | | | | 2 | 2 |
| Ballistics | 34 | | | | | | |
| All calibers | | 1.9.1 | 2 | | | | |
| 23-mm | | 1.9 | | | 1 | 2 | |
| 57-mm | | 2.0 | | | | 1 | |
| Probability of Hit | 35 | 1.9 | 2 | | | | |

1 = No errors found (correct implementation/excellent correlation)
2 = Minor discrepancies (basically correct implementation/good correlation)
3 = Major errors (incorrect implementation/poor correlation)

Verification results are reported in Section 2 for 14 FEs. Detailed verification of the MTI function in v.1.8 revealed several anomalies, and users should execute v.1.8 models with the MTI function disabled. A new algorithm was implemented in v.1.9, however, detailed re-verification has not yet been performed. Users should refer to the MTI CMS section in ASP-II for more information on the new implementation. Potential problems exist in the interface to the probability of detection model as seen in the signature fluctuations (acquisition mode) and integration FEs. Users should select the threshold model if possible. Errors uncovered during verification of both the Descriptive and Numerical clutter models in v.1.8 resulted in corrections to v.1.9. These corrections have not been verified. The probability of hit FE produces different results when switching between 6- and 26-view target representations due to different implementations of the target presented area calculation. Users should use the 26-view option if possible. The remaining anomalies have to do with potential software execution problems (e.g., underflow or overflow conditions), documentation deficiencies, and a lack of documented sources for algorithms and constants used in the code. Although these anomalies should be corrected, they should not significantly affect model performance.

Section 3 contains validation results for 9 FEs. Anomalies reported on angle and range track in v.1.8 lead to new implementations of those FEs in v.1.9. Validation efforts revealed an incorrect implementation of the drag function for 57-mm projectiles in v.1.9. A new function was implemented in v.2.0 and correlation with intelligence data is good. Of the minor discrepancies reported (on the most current version), none should significantly impact model performance.

Model-level comparisons with AGC voltages, tracking errors, and gun-pointing angles derived from operational testing resulted in good correlation over selected portions of each flight. Introducing target fluctuations significantly improved correlation with angle errors,

but did not significantly impact range errors, AGC voltages, or gun-pointing angles. In many cases, validation efforts were limited by the accuracy that can be obtained in range test measurements.

With the exception of 57-mm ballistics in v.1.9, no problems were serious enough to suggest limiting application of the model to specific types of problems, but areas of interest involving countermeasures and low-observable targets have not yet been addressed due to a lack of test data. It is anticipated that additional problems may be discovered when further exploration of gun and operator functions is conducted.